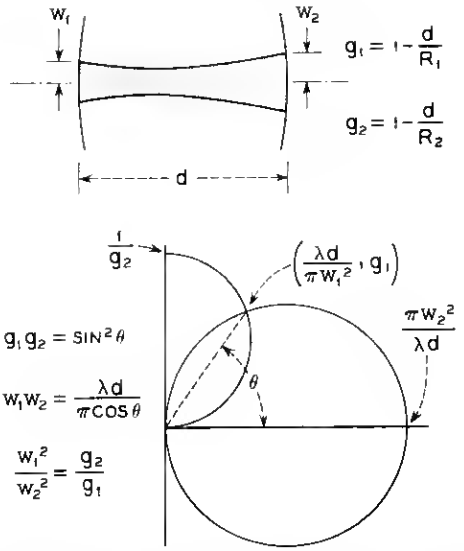

FIG. 1 — Circle diagram for spherical mirror resonators. Cartesian coordinates of the important points are indicated, along with some geometrical relationships.

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Gas Pumping in Continuously Operated Ion Lasers

By E. I. GORDON and E. F. LABUDA

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Gas ion lasers[1] operate at discharge currents of several amperes in small-bore tubing. Under these conditions the discharge acts to pump gas from the cathode to the anode[2] and pressure differences in excess of 10:1 can be established in less than one minute of discharge operation. Since the optimum pressure range for laser operation is narrowly defined relative to the range of pressures existing in the discharge tube (see Fig. 1), laser action usually deteriorates or goes out shortly after turn-on.

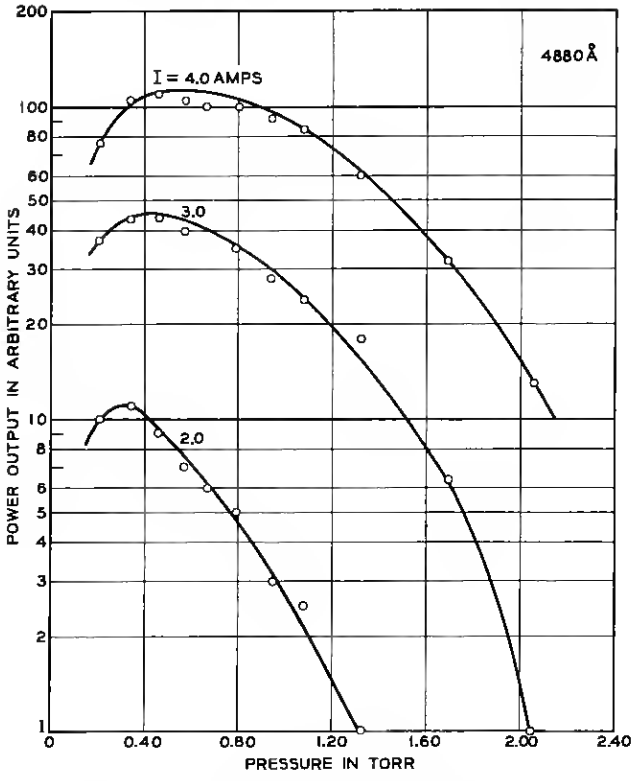

Fig. 1 — Laser output vs pressure at various discharge currents.

When the discharge is turned off for several seconds to allow the pressure to equalize and then turned on again, the output returns to its initial value only to deteriorate again.

By placing a connecting tube of high gas flow conductance between the anode and cathode as shown in Fig. 2, the pressure difference between the anode and cathode can be virtually eliminated. Tubes operated with the connecting tube show no deterioration over long periods of time. The tube length and bore are chosen so that the sustaining voltages for the two paths are comparable.

The connecting tube is fashioned in the form of a helix to relieve any strains that might develop from differential expansion and because a helix provides a convenient means of getting a long length of tubing into a small volume.

The connecting tube also serves to eliminate gas separation or cata-

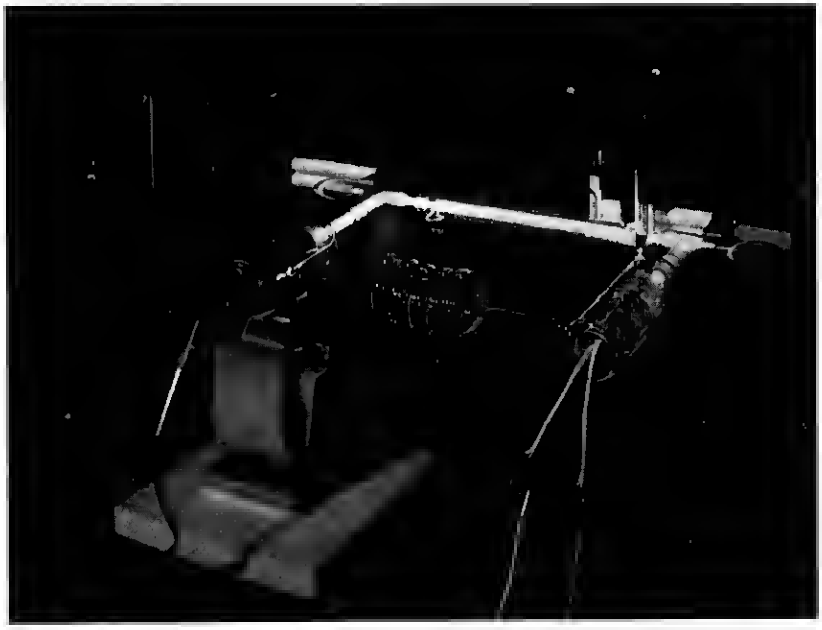

Fig. 2 — Photograph of laser illustrating the connecting tube.

phoresis that occurs when using mixed gases. This is of particular importance in dc-excited laser discharges such as helium-xenon.[3] Cataphoresis is no special problem in the helium-neon discharges in the current range at which they are operated, and the side tube is unnecessary.

We are indebted to J. T. Bannon, who constructed the experimental tubes.

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